The Impact of Depressive Symptoms and Chronic Diseases on Active Life Expectancy in Older Americans

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Objectives: The authors prospectively examined whether depressive symptoms (DS) in older adults negatively affected active life expectancy (ALE), or remaining years free of disability, and mortality, independently and in the presence of chronic diseases, and after stratification by gender. Design: Prospective cohort study, first three waves (1993–1998) of the Asset and Health Dynamics Among the Oldest Old. Setting: Data collection: University of Michigan; analysis: University of South Florida. Participants: Nationally representative sample of community-dwelling adults age 70 and older (N = 7,381). Measurements: DS (Center for Epidemiological Studies Depression, 8-item version), self-reported cancer, diabetes, heart disease, or stroke, difficulty with activities of daily living, death, and estimates of total, active, and disabled life expectancy. Results: DS reduced ALE by 6.5 years for young–old men (age 70), 3.2 years for old–old men (age 85), 4.2 years for young–old women, and 2.2 years for old–old women, and these effects remained significant at all ages and across gender even after controlling for chronic disease, the one exception being DS and cancer in old–old women. DS also reduced total life expectancy significantly, although controlling for some chronic diseases (particularly cancer and stroke) eliminated the effect of DS across age and gender groups. Conclusion: Depressive symptoms represent a serious and distinct threat to independent functioning in older adults. Whether experienced alone, or in combination with chronic diseases, depressive symptoms shorten ALE substantially. Timely diagnosis and treatment of depressive symptoms in older adults may delay the onset of disability and improve the quality of life. (Am J Geriatr Psychiatry 2008; 16:425–432)

Key Words: Depressive symptoms, chronic disease, disability, mortality

Depressive symptoms (DS) are widely acknowledged to have negative effects on the health and well-being of older adults. However, the literature on the effects of depressive symptoms on mortality...
and disability is complex. In this article, we will review the current state of knowledge on the effects of DS on mortality and disability, and report results of a large, prospective study utilizing the methods of active life expectancy (ALE) analysis to provide further understanding of the effects of DS.

Effects of Depressive Symptoms on Mortality

Although the literature strongly suggests that depression increases mortality, a comprehensive review found that only half of studies found an association between depression and increased mortality. One recent longitudinal project found that DS alone did not predict excess mortality, unless also accompanied by loneliness, however, another recent study has found increased death rates among patients with depression, even after controlling for cardiac disease and diabetes. In another study, where participants in the MRFIT project were followed up for 18 years, DS were associated with increased mortality. A study of patients followed after stem cell transplantation found depression associated with increased mortality with a 5-year follow-up. Another recent study found that DS did not predict mortality except in the presence of comorbid diabetes, whereas another found little impact of depression (measured by the Geriatric Depression Scale) on mortality after controlling for chronic conditions and cognitive function. The link between DS and mortality, then, is unclear and may be dependent on the nature of the sample and duration of follow-up.

Effects of Depressive Symptoms on Disability

In contrast to the somewhat mixed findings on mortality, the evidence that DS increase disability in older adults is strong and fairly consistent, even when controlling for the effects of disease. Verbrugge and Jette conceptualize the disablement process as beginning with some kind of illness or pathology, followed by impairment of bodily systems, functional limitations, and then disability. This is consistent with the common perception that disability can either occur independently, or as a result of medical conditions, thereby elevating the risk and degree of disability. Nevertheless, DS impair health and lower the quality of life in association with chronic illness and DS have been shown to affect controls of strength, speed, or range of motion vital to the performance of activities of daily living (ADLs), and instrumental activities of daily living (IADLs).

In addition, Ormel et al. found a temporal and reciprocal relationship in the effects of DS on disability. Using structural equation models that varied the direction and speed of effects, they concluded that disability and DS effects are simultaneous, although they also found weak evidence for effects in both directions. There is additional evidence that the effect of DS on disability occurs over a long period compared with the relatively quicker and stronger onset of disability brought on by medical conditions. Indeed, DS led to a fivefold increase in disability in individuals with diagnosed depression compared with nondepressed individuals. Although there is conflicting evidence on the time order of the DS disability relationship, the strength of the relationship is not really in doubt.

DS and Chronic Conditions

DS are often comorbid with chronic diseases such as heart disease, cancer, stroke, and diabetes, commonly disabling conditions that can cause a decline in physical functioning in areas of mobility, strength, and quality of life. Other studies suggest that chronic conditions result in depression, conditions including hypertension, diabetes, and heart disease. Others suggest, for example, that depression may make older adults more vulnerable to cardiac diseases.

With diminished quality of life as a result of chronic illness, DS often affect older adults negatively, amplifying disability, mortality, and hindering their ability to recover from disability. According to Lenze et al., depression impacts physiological and cognitive performance, and behavior in the course of the chronic condition, increasing disability and mortality. Health behavioral factors, such as poor adherence to treatment and medication, and poor nutrition, present barriers to the proper management of chronic diseases resulting in higher disability and mortality as a result of the impact of late-life depression.

Moreover, support from the literature predicts that older adults with chronic diseases already have a predisposition to DS, suggesting a higher likelihood of disability and mortality. Our study addresses an
important gap in the existing literature. Our research simultaneously examines the impact of DS as an independent factor predicting both disability and mortality, with and without chronic diseases, in a nationally representative sample of adults age 70 and older.

Active Life Expectancy

ALE combines mortality and disability conceptually by estimating total life expectancy (TLE)—the average number of years a person of a specific age can expect to live—and disabled life expectancy (DLE)—the average number of those remaining years a person can expect to live with disability. ALE, then, would be the difference between TLE and DLE. For example, in a study by Crimmins et al.,18 TLE at birth was determined to be 71.8 years for men and 78.8 years for women. For men, 58.8 (81.2%) of those years would be lived without disability; for women, 63.9 years would be lived disability-free (81.0%). Studies have regularly estimated ALE for the older population based on ability to perform basic personal care (ADL) and IADL functioning.18–20 Such studies have demonstrated the value of this approach to understanding complicated differentials in mortality and disability by a variety of factors, such as race and gender.21 In this study, we define ALE as the average amount of remaining life a person of a given age can expect to live without ADL disability.

The objective of this article is to estimate the impact of DS on disability or mortality independent of chronic disease in men and women over 70 years of age in the United States. Our work addresses two hypotheses: 1) DS will decrease both TLE and ALE; and 2) the combination of DS and chronic diseases (CD) will significantly further decrease TLE and ALE compared with the CD alone. We analyze these effects separately by gender because of well-documented gender differences in mortality and disability in late life.22–24

METHODS

Data

We use the first three waves of the Asset and Health Dynamics Among the Oldest Old (AHEAD) study for this analysis. The AHEAD data were collected by the University of Michigan; details on the AHEAD survey design and procedures are readily available and are not repeated here.25 The first wave was collected in 1993–1994, the second wave in 1995–1996, and the third wave in 1998. The 1993–1994 baseline sample began with interviews of 8,222 individuals who were a representative sample of community-dwelling adults age 70 and older and their spouses or partners. After excluding all those under the age of 70 (n = 530), those for whom dates of birth (n = 57), dates of death (among those known to have died between 1993 and 1998; n = 4), and initial or subsequent functioning status (n = 250) could not be determined, the study sample consists of 7,381 persons in 1993. This sample was followed up through the third wave, by which time 1,894 had died. Deaths and the date of death were determined through the National Death Index (NDI), as well as reports of survivors. The date of death provided by the NDI was used when available; when no date was available from NDI, the survivor-provided date of death was used. All results were weighted to reflect the 70+ population.

Measures

Active Life Expectancy. We defined ALE as having no self-reported difficulty performing any functions necessary for ADLs; disabled life was having difficulty in one or more of six ADLs. These activities included walking across a room, bathing or showering, eating, dressing, toileting, or transferring in or out of bed. In addition, although the original sample consisted solely of community-dwelling older adults, respondents residing in a nursing home at either wave 2 or wave 3 were defined as disabled.

Depressive Symptoms. AHEAD measures DS at baseline with a shortened version of the Center for Epidemiological Studies Depression (CES-D) scale. The AHEAD version contains eight items, five of which measure mood, and three of which measure the psychosomatic dimension.25 We dichotomized the presence of DS by coding those with six or more indicators as having high DS, otherwise not, as suggested by the Turvey et al.26 analysis of the short form of the CES-D. Although the CES-D is clearly not as precise as a clinical diagnosis of depression, it is
the only measure available in the AHEAD survey at baseline.

Chronic Diseases. We chose major causes of mortality and disability in older adults—cancer, diabetes, heart disease, and stroke.27 Respondents were asked to report the presence of chronic medical conditions, among which were cancer, diabetes, heart disease, or stroke. For cancer, respondents were asked: “has a doctor ever told you that you have cancer or a malignant tumor, excluding minor skin cancers?” The diabetes question was simply: “do you have diabetes now?” For heart conditions, the question was “has the doctor ever told you that you had a heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems?” We coded these questions as 1 – yes, or 0 – no. Finally, the question about stroke was “has a doctor ever told you that you had a stroke?” Response categories included 1 – yes, 2 – transient ischemic attacks, or 0 – no. We coded stroke as 1 – yes, only if the respondents indicated that they had a stroke, 0 if they indicated transient ischemic attacks or no stroke.

Statistical Analysis

We used a multistate life table method to estimate TLE and ALE appropriate for use with longitudinal data. The multistate method takes into consideration the fact that persons experience both declines and improvements in disability; it also allows different mortality profiles by disability state.18 For the estimation of ALE, we designated two live states, 1) active, no difficulties with any of the six ADLs listed above, and 2) disabled, difficulty with at least one of the six ADLs, and one absorbing state, dead (Fig. 1). During the 5-year period we examined, individuals could make transitions between these states: 1) from active to disabled; 2) from disabled to active; 3) from active to death, and 4) from disabled to death. Estimates of ALE and DLE were derived from age-specific transition rates for those with or without DS; these rates were then reestimated for those with or without DS in the presence of each of the chronic diseases.

We used the Interpolation of Markov Chains (IMaCh) approach, which is designed to incorporate multiple waves of data and different interval lengths between survey waves.28–29 This approach uses a multinomial logistic regression approach to estimate annual age-specific health transitions. These transition rates are used to estimate TLE, ALE, and DLE.18 IMaCh also can incorporate cases with missing data, and produces standard errors and confidence intervals for the age-specific transition schedules and life expectancy estimates. Depressive symptoms and individual chronic diseases are included as covariates.

For estimations of TLE, ALE, and DLE, we present results for 70- and 85-year olds to approximate results for the young–old and the old–old. Each table presents the number of average years estimated, including 95% confidence intervals. Standard deviations are not available, as these are estimates from the analysis, and not descriptive values. To test differences between groups, for example, TLE between men with or without DS, we present the test of equality for each pair of mean health expectancies, random variables assumed to be independent and therefore assumed to have normal distributions,30 presenting the z test, number of observations, and p value.

RESULTS

Depressive Symptoms and Active Life Expectancy

In Table 1, we address our first hypothesis that DS alone will decrease both TLE and ALE in men at the ages of 70 and 85. As shown in Table 1, for men at age 70, the average TLE is significantly reduced in the presence of DS by 3.5 years compared with the average TLE for those without DS, from 14.3–10.8
years, and average ALE is reduced by 6.5 years. For men at age 85, TLE is significantly reduced 1.6 years by DS, and ALE is significantly reduced by 3.2 years.

Table 2 presents similar estimates for women at the same ages. For 70-year-old women, DS significantly lowers TLE by 2.9 years, and also significantly reduces ALE by 4.2 years. Women at age 85 with DS lose 1.8 years in TLE compared with those without DS, while also significantly losing 2.2 active years.

**Depressive Symptoms, Chronic Diseases, and Active Life Expectancy**

In Tables 1 and 2, we also present estimates of the effects of each of the four CDs—cancer, diabetes, heart disease, and stroke—on TLE and ALE, along with similar estimates for DS combined with each of the CDs. For men and women at both age 70 and 85, each of the CDs significantly reduce the TLE and ALE. For example, in 70-year-old men, cancer reduces TLE by 4.2 years, and ALE by 3.8 years.

To address our second hypothesis—that DS and the CD together will significantly further reduce TLE and ALE, compared with the disease alone—we compare estimates of 70-year-old men with DS and cancer to those of 70-year-old men with just cancer, and so on. Table 1 results indicate that, for 70-year-old men, TLE is further reduced significantly for DS and diabetes with 3 more years of life lost, and DS and heart disease with 1.6 more years of life lost. DS together with cancer does not significantly further reduce TLE, nor does DS with stroke. However, DS in combination with each of the four CDs significantly further reduces ALE, ranging from a further reduction of 2.8 active years for DS and cancer, to 6.6 active years for DS and heart disease. For 85-year-old men, DS does not further reduce TLE in combination with any of the CDs, but DS with each of the CDs significantly further reduces ALE, ranging from 1.1 fewer active years for DS and cancer, and DS and stroke, to 1.4 fewer active years for DS and heart disease.

Table 2 results indicate that, for 70-year-old women, TLE also is further reduced by CD and DS, but in this case, only the combination of DS and stroke does not significantly further reduce TLE. The
**CONCLUSIONS**

Our first hypothesis suggested that DS would decrease both TLE and ALE at both ages. For both TLE and ALE, the hypothesis was consistently supported and effects were strong. The magnitude of this effect on TLE ranged from 1.6 years for men at age 70 to 3.5 years for men at age 85; the ALE effect ranged from 2.2 years in women at age 85 to 6.5 years in men at age 70.

Our second hypothesis suggested that the combination of DS with the chronic diseases would further reduce both TLE and ALE for both ages, compared to estimates for those with just the CDs. Again, for ALE, the effects of DS were consistent and strong. After controlling for the effects of cancer, diabetes, heart disease, and stroke, DS resulted in significantly lower ALE for 70-year-old men and women, and for 85-year-old men. For 85-year-old women, DS remained significant after controlling for diabetes, heart disease, and stroke, but not cancer. Thus, the effects of DS on ALE are robust and are not explained by CD alone.

However, the effects are more complicated in considering the effects of DS on TLE, where results vary both by gender, age, and chronic condition. Men at age 70 have reduced TLE by DS in combination with diabetes and heart disease only, whereas 70-year-old women have reduced TLE in combination with cancer, diabetes, and heart disease. At age 85, the reduction of TLE by the CD is not further reduced by having DS for men, whereas for 85-year-old women, it is reduced by DS.

**TABLE 2. Total (TLE), Active (ALE), and Disabled (DLE) Life Expectancy in Years (95% Confidence Intervals [CI]): AHEAD: 1993–1998; Women Age 70 and 85, with and without Depressive Symptoms (DS); with and without Chronic Diseases (CD)**

<table>
<thead>
<tr>
<th>Age 70</th>
<th>TLE Mean (CI)</th>
<th>ALE Mean (CI)</th>
<th>DLE Mean (CI)</th>
<th>n</th>
<th>TLE Significance of Differences</th>
<th>ALE Significance of Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>No DS, No CD</td>
<td>17.6 (16.9–18.3)</td>
<td>12.3 (11.7–12.8)</td>
<td>5.3 (4.8–5.8)</td>
<td>3,818</td>
<td>z = 2.318, p = .010&lt;sup&gt;a&lt;/sup&gt;</td>
<td>z = 4.896, p = .001&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>DS, No CD</td>
<td>14.7 (13.1–16.4)</td>
<td>8.1 (6.9–9.2)</td>
<td>6.7 (5.7–7.9)</td>
<td>3,818</td>
<td>z = 4.009, p = .001&lt;sup&gt;a&lt;/sup&gt;</td>
<td>z = 3.823, p = .001&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cancer only</td>
<td>13.8 (12.6–14.9)</td>
<td>9.6 (8.7–10.4)</td>
<td>4.2 (3.5–4.9)</td>
<td>3,818</td>
<td>z = 2.249, p = .015&lt;sup&gt;a&lt;/sup&gt;</td>
<td>z = 4.225, p = .001&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>DS and cancer</td>
<td>10.7 (9.2–12.2)</td>
<td>5.7 (4.7–6.6)</td>
<td>5.1 (3.9–6.2)</td>
<td>35</td>
<td>z = 6.574, p = .001&lt;sup&gt;a&lt;/sup&gt;</td>
<td>z = 8.787, p = .001&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Diabetes only</td>
<td>11.7 (10.7–12.7)</td>
<td>6.6 (5.9–7.3)</td>
<td>5.1 (4.4–5.8)</td>
<td>60</td>
<td>z = 2.752, p = .005&lt;sup&gt;a&lt;/sup&gt;</td>
<td>z = 6.187, p = .001&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>DS and diabetes</td>
<td>8.2 (6.7–9.7)</td>
<td>2.0 (1.3–2.7)</td>
<td>6.2 (5.0–7.3)</td>
<td>32</td>
<td>z = 5.322, p = .001&lt;sup&gt;a&lt;/sup&gt;</td>
<td>z = 6.758, p = .001&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Heart disease only</td>
<td>13.4 (12.7–14.2)</td>
<td>8.4 (7.8–9.0)</td>
<td>5.0 (4.5–5.5)</td>
<td>132</td>
<td>z = 2.466, p = .007&lt;sup&gt;a&lt;/sup&gt;</td>
<td>z = 5.388, p = .001&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>DS and heart disease</td>
<td>10.8 (9.4–11.5)</td>
<td>4.7 (3.9–5.5)</td>
<td>6.1 (5.1–7.1)</td>
<td>32</td>
<td>z = 5.939, p = .001&lt;sup&gt;a&lt;/sup&gt;</td>
<td>z = 8.800, p = .001&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Stroke only</td>
<td>11.4 (10.2–12.7)</td>
<td>5.8 (4.9–6.7)</td>
<td>6.7 (4.7–6.6)</td>
<td>3,818</td>
<td>z = 1.063, p = .144&lt;sup&gt;a&lt;/sup&gt;</td>
<td>z = 1.738, p = .041&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>DS and stroke</td>
<td>9.9 (8.4–11.5)</td>
<td>4.3 (3.5–5.1)</td>
<td>5.7 (4.4–6.9)</td>
<td>32</td>
<td>z = 2.593, p = .001&lt;sup&gt;b&lt;/sup&gt;</td>
<td>z = 6.746, p = .001&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>Significance of z-scores comparing resultant TLE from those with just the chronic disease.

<sup>b</sup>Significance of z-scores comparing resultant ALE from those with no CD and no DS.

<sup>c</sup>Significance of z-scores comparing resultant TLE from those with no CD and no DS.

<sup>d</sup>Significance of z-scores comparing resultant ALE from those with just the chronic disease.

<sup>z</sup>Significance of z-scores comparing resultant ALE from those with just the chronic disease.

range of significant reduction in TLE goes from 2.6 lost years for DS and heart disease to 3.5 years for DS with diabetes. In contrast, ALE is further reduced by CD and DS in all cases. Significant reductions in active years range between 1.5 years for DS and stroke to 4.6 years for DS and diabetes. For 85-year-old women, DS significantly further reduces TLE only in combination with diabetes, by 1.4 years. In contrast, DS with all but cancer significantly further reduces ALE, ranging from 0.5 fewer active years for DS and stroke to 1.4 years for DS and diabetes.
only in the case of DS and diabetes. Therefore, the effects of DS on TLE are less consistent than the effects of DS on ALE, once chronic diseases are controlled.

This study examines a cohort of older adults who grew up in a time when diagnosis of and treatment for DS carried a certain stigma. Combining this stigma with the conventional wisdom that DS in older adults is a byproduct of chronic diseases, it is not surprising that DS in today’s older adults are frequently overlooked as a serious health issue. Our findings strongly suggest that DS in older adults are an important factor in lengthening the period of remaining life with disability, even though the DS effects on mortality are less consistent.

There are limitations to a study of this kind, principally the reliance on self-reported health conditions, and the use of DS as a proxy for clinically diagnosed depressive symptoms; the CESD-8 was the only measure of depressive symptoms available at baseline. It should be noted that DS were measured using a more detailed measure than was used with CD, which was assessed only with a single item. Ideally such research should use clinical examination to assess both DS and CD, although this effort is expensive for such a large sample size. However, we feel that the representative nature of the sample provides its own reason to regard this study as important and meaningful.

A further limitation lies in the nature of the multistate life table method, which measures transitions between functional status measured at three distinct times, the interview dates. Consequently, multiple transitions between states that occur within each interval between survey dates remain unobserved; this also is a limitation imposed by both the data and the methodology. Finally, the IMaCh software at present limits us to the use of only two covariates; thus, we are unable to further control for such important potential factors such as marital status, education, obesity, and the like. Even if we were able to utilize such controls, the cell sizes would be too small to make reliable estimates at advanced ages.

Nonetheless, we believe that this study makes an important contribution to understanding the relationship between DS, mortality, and disability. Our methods are unique in applying the construct of active life expectancy to the understanding of the effects of DS. Our results make it clear that DS decrease the total number of years lived, and even after controlling for chronic diseases, increase the years of life lived with a disability.

Although DS are too often undetected and untreated in older adults, evidence that DS can be effectively treated in late life with either psychotherapy or pharmacotherapy makes it all the more important that efforts be heightened to effectively reach older adults with DS, particularly because DS with chronic conditions may lead to medication non-compliance. Physicians should be aware of this possible problem in treating DS in older patients. Recent evidence suggests that treatment of DS also improves physical functioning in older patients, and that treatment can be carried out successfully in primary care settings. Further dissemination of effective strategies for treatment of geriatric DS have the ability to make long-term improvements in both the length and quality of life in older adults.

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References